

**Effects on Brain Network by Simultaneous Dual-mode
Stimulation in Subacute Stroke Patients**

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Protocol

Repetitive transcranial magnetic stimulation (rTMS) or transcranial direct current stimulation (tDCS) has been used for the modulation of stroke patients' motor function by altering the cortical excitability. Recently, more challenging approaches, such as stimulation of two or more sites or use of dual modality have been studied in stroke patients. In this study, simultaneous stimulation using both rTMS and tDCS (dual-mode stimulation) over bilateral primary motor cortices (M1s) was investigated to compare its modulatory effects with single rTMS stimulation in subacute stroke patients.

Twenty-four subacute stroke patients were recruited for this study. The inclusion criteria were patients who had suffered their first-ever stroke within 4 weeks of entering the study and had a total Fugl-Meyer Assessment (FMA) score under 84. The exclusion criteria were patients who had a major active underlying neurological disease or psychiatric disease, a history of seizure, or metallic implants in their brain. Twelve participants were assigned to the dual-mode stimulation group (rTMS on ipsilesional M1 and tDCS on contralesional M1) and the other twelve participants were assigned to the single stimulation group (only rTMS on ipsilesional M1).

A randomized, open-label, parallel study design was adopted in this study. All participants underwent ten daily sessions of stimulation for 2 weeks under one of two different conditions. In the dual-mode stimulation group, 10 Hz of rTMS was applied over the ipsilesional M1 for 20 minutes with simultaneous application of cathodal tDCS on the contralesional M1. In the single stimulation group, only 10 Hz of rTMS over the ipsilesional M1 was applied. Investigators assessed each participant's total FMA score and acquired their resting-state fMRI data at two times: prior to stimulation (pre-stimulation) and 2 months after stimulation (post-stimulation).

Statistical analysis

The Shapiro-Wilk test was performed to test data for normal distribution. The null hypothesis was rejected in all cases. Repeated-measures ANOVA was performed to determine whether there were any significant differences between group and time (pre-stimulation and post-stimulation) effects in the resting-state network measures. Paired t-tests were used to evaluate within-group differences over time. Post-hoc analysis with the Bonferroni correction was also performed. The repeated-measures ANOVA and paired t-tests were performed using *ranova* and *ttest* functions, respectively, in the statistics toolbox of Matlab R2014b. The threshold for statistical significance was set at $p < 0.05$ for this study.